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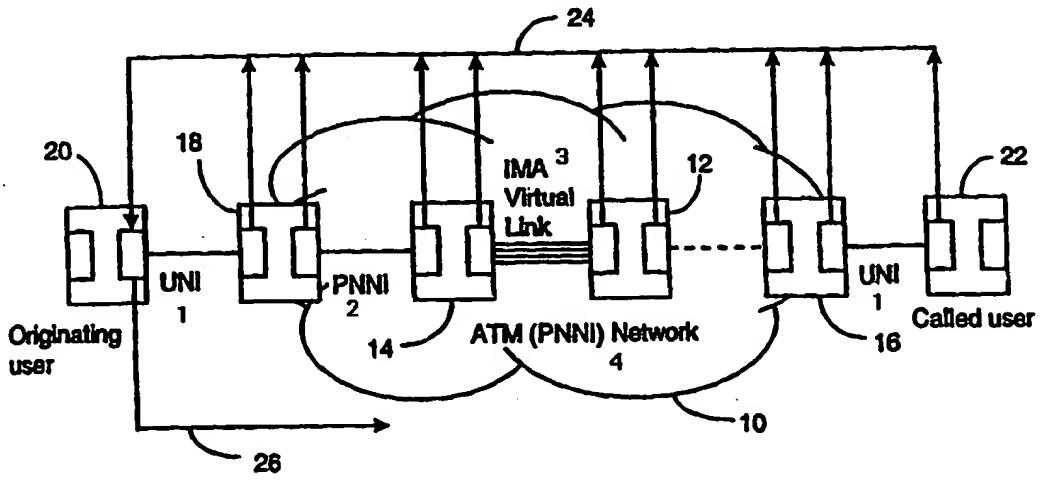

(57) Abstract

Techniques of managing resource requirement of a connection in an ATM network are disclosed. The techniques add a new information element in the existing "setup" message and add a new signalling message to complement the existing Q.2725.2/Q.2963.2 (connection modify) message which is generated by the connection originating user. When a circumstance requiring a change in the resource requirement for an active connection is encountered, any network element of the network provider and the called user sends a resource change indication message to the connection owner who upon receiving such a message initiates the Q.2725.2/Q.2963.2 (connection modify) procedures, calls clearing procedures or rerouting procedures.

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RESOURCE MANAGEMENT OF AN ATM CONNECTION

Field of Invention

The invention generally resides in the field of resource management in an ATM network. In particular, it is directed to techniques of managing changes in network resources such as bandwidth utilization and its provision for an ATM connection.

Background of Invention

Because the bandwidth availability and demand are continuously changing in an ATM network, designing a perfectly engineered network is not always a feasible task. Also, when a network experiences unexpected failure, protection switching may not always be a solution since contention for network resources can still happen and subsequently, the quality of service (QOS) will degrade. Most importantly, the cost of providing ATM services rises as extra resources are provisioned to sustain the ATM traffic under overload condition which may not happen too often. Therefore, designing a capability which allows flexible resource management is extremely useful to manage the network operation.

ATM Forum agrees on the concept of the resource management per connection upon dynamic bandwidth changes in IMA (inverse multiplexing for ATM), WATM (wireless over ATM), ADSL (asymmetrical digital subscriber loop), LANE (Lan Emulation), MPOA (Multi-Protocols Over ATM) etc. It addresses a mechanism of preserving QOS and maximizing link utilization over any kind of links which is experiencing dynamic bandwidth changes.

ITU-T defines signalling procedures to modify the PCR, SCR and MBS (Q.2725.2, Q.2963.2) for an active connection. This procedure can be a useful function to deal with dynamic bandwidth management issues. However, the existing signalling procedures for Q.2725.2/Q.2963.2 feature allow only the connection owner to initiate the modify request. This limited capability is not sufficient for an ATM network to support the variety of technologies as discussed above.

The invention solves the above stated problems by introducing a new signalling capability which can be used to complement the Q.2725.2/Q.2963.2 "connection modify" feature to support dynamic

resource management. -The new signalling capability consists of a new information element (i.e. dynamic bandwidth change options) to be added to the existing signalling "setup" message, and a new signalling message which is called "bandwidth change indication". But it should be noted that although the bandwidth is described as one example of resources, other properties can be used in place of the bandwidth. The new information element allows the connection owner to specify its desired network resource management to the network operation and the called party. The new message carries the expected traffic parameters that the network or called party can sustain. It therefore allows the connection owner to initiate the proper maintenance action (e.g. release request, bandwidth modification request, or rerouting request) more effectively.

Objects of the Invention

It is therefore an object of the invention to provide a mechanism for managing changes of resources requirements for an ATM connection.

It is another object of the invention to provide a mechanism for managing bandwidth requirement of an ATM connection.

It is yet another object of the invention to provide a mechanism for managing bandwidth requirement of an ATM connection by the use of ~~a~~ signalling messages together with a connection bandwidth modification feature.

It is yet another object of the invention to provide a mechanism for managing bandwidth requirement of an ATM connection by the use of signalling messages together with a connection rerouting feature.

Summary of the Invention

Briefly stated, the invention resides in the field of resource management in an ATM network. In accordance with one aspect, the invention is directed to a method of managing the resource demand of an active connection which comprises steps of receiving a resource change at an connection owner, the message indicating a resource change request, and sending downstream a resource management option chosen in response to the resource change request. The method further includes a

step of exchanging traffic on the connection conforming to the resource management option when said option is acknowledged.

According to another aspect, the invention is directed to a method of managing the resource requirement of an active connection which comprises steps of receiving a resource change message on the connection at a connection owner, the message indicating a bandwidth change request and sending a modify message downstream of the connection indicating a new bandwidth for the connection. The method further includes a step of sending traffic on the connection conforming to the new bandwidth when the modify message is acknowledged.

Brief Description of the Drawings

Figure 1 is an overview of a bandwidth change indication message in n ATM environment.

Figure 2 shows a format of a dynamic bandwidth management option IE.

Figure 3 shows flows of the "bandwidth change indication" and "connection modify" messages.

Detailed Description of Preferred Embodiments of the Invention

As described earlier, connections through an ATM network at various times undergo changes in requirement or demand for a variety of resources, one such typical resource being a bandwidth requirement. Whether or not a requested bandwidth change will be granted depends on many factors, such as, the condition of the network, an agreement of the user with the network operator, the capability of the user's equipment, etc. According to the ITU-T Q.2725.2/Q.2963.2 procedures, the "connection modify"-feature permits the connection originator to inform the network and the destination that it wishes to modify the traffic parameters of an active connection. It informs them of new desired traffic parameters and waits for acknowledgement and/or approval before it invokes procedures for the actual change.

As mentioned earlier, the ITU-T Q.2725.2/Q.2963.2 connection modify feature can be initiated only by the connection owner (originator). The invention provides mechanisms for adjusting resource requirements

of a connection not only by the connection originator but by the network as well as the called user. The network includes any network nodes and network elements that have any bearing on the connection concerned.

According to one embodiment, the existing ITU-T Q.2725.2/Q.2963.2 connection modify feature can be utilized more effectively by the use of new signalling mechanisms. The new signalling mechanism composes of a new signalling information element "dynamic bandwidth management option" and a new signalling message "bandwidth change indication". The existing "setup" message is modified to include the new information element (IE for short) to specify dynamic bandwidth management options that the network and the called party can be implemented. This IE is specified by the connection owner and is sent to the network or the called party in the "setup" message during the initial connection establishment phase. The IE informs them of the connection owner's desired dynamic bandwidth management options for point-to-point calls/connections and for the first user of point-to-multipoint calls/connections. Many options are possible but some typical options are:

- no action;
- clear call, if there is insufficient bandwidth; and
- indicate the new bandwidth requirements

Based on the management option given by the connection owner, the network and the called user for that connection can determine the type of management action to perform when they encounter circumstances that require modification in resources on the connection. If the resources to be altered are the bandwidth requirement, it may be accomplished by the connection bandwidth modify procedures or rerouting. The invention permits these procedures be initiated by not only the connection owner but the network and the called user. If dynamic bandwidth management option IE is absent in the "setup" message, it implies that no specific management option is expected by the connection owner from the network or the called party. However, it does not imply that the network cannot perform its own desired maintenance.

According to one embodiment, when the network or the called user decides to modify the connection bandwidth for a connection as part

of the management options, it will send a "bandwidth change indication" message to the connection owner with the following information included in the message:

- request of the overall changes to the connection characteristics using the alternative ATM traffic descriptor, or;
- request of the change of peak cell rate traffic parameters using the minimum acceptable ATM traffic descriptor.

The use of the alternative ATM traffic descriptor information element indicates the new acceptable values for all traffic parameters whereas the use of the minimum acceptable ATM traffic descriptor is restricted to the indication of peak cell rates and ABR minimum cell rates which are the information specific for ABR connection. This dynamic bandwidth management procedure of the invention applies to CBR, rt-VBR and nrt-VBR, ABR and UBR and GFR ATM service category calls.

In this specification the description is mainly limited to the management of the bandwidth requirement as the resource management but as mentioned earlier, it should be emphasized that the concept is equally applicable to other resource parameters which can be specified in the information element of the connection modify message or resource change message.

Figure 1 is an example of the bandwidth change indication operation in an ATM network, according to one embodiment of the invention. In the Figure, an ATM network 10 contains a variety of nodes 12, 14, 16 and 18, each having a variety of capabilities. As an example, nodes 12 and 14 are shown to be holding an IMA virtual link. Different interfaces link different pair of nodes, one being defined by ATM Forum under PNNI (Public Network Network Interface). Interfaces between a customer and an ATM node are defined in UNI (User Network Interface). Therefore a calling user 20 and a called user 22 are linked with respective nodes through UNI. For an illustration purpose, a path has been established between the calling user and the called user through nodes 18, 14, 12, and 16. The link between node 12 and 16 is shown as being of any kind. It should be emphasized that the links shown in the Figure are examples only. There are many different interfaces available in the field

that can be used in this invention. Each node is able to initiate a "bandwidth change indication" message, when conditions warrant it.

In order to support this dynamic bandwidth change capability, the connection owner must include dynamic bandwidth management option information element in the "setup" request. Some typical management options are described earlier. This information is necessary for the network and/or the called user to be aware of the type of management option that can be provided by the connection owner for the dynamic bandwidth change.

Any one or more of network elements located at any of the nodes shown in Figure 1 can initiate bandwidth change indication procedure as shown by numeral 24. It is done by sending to the connection owner a "bandwidth change indication" message. The connection owner then initiates connection modify procedures as shown by numeral 26.

Since a link is directly controlled by two adjacent nodes, therefore, it would be useful to designate one particular node to initiate the bandwidth change indication in order to synchronize the maintenance action. By default, the following rules are applied to the adjacent peers which manage the affected link. However, it is just the default option and shall be allowed to be overridden by the network provision.

1. In the case of originating UNI, the network side initiates a "bandwidth change indication" message which is sent towards the calling user.
2. In the case of destination UNI, the called user (i.e. user side) initiates a "bandwidth change indication" message which is sent towards the calling user.
3. In the case of PNNI, the succeeding side initiates a "bandwidth change indication" message which is sent towards the calling user.
4. In the case of AINI, the succeeding side initiates a "bandwidth change indication" message which is sent towards the calling user.

The "bandwidth change indication" message contains one of the following information elements:

- the alternative ATM traffic descriptor IE to indicate the overall changes to the connection cell rate for a CBR or VBR connection.

- the minimum acceptable ATM traffic descriptor IE to indicate the changes for the peak cell rate parameter for a CBR, VBR, ABR or UBR connection.

Figure 2 shows a format for dynamic bandwidth management option IE according to one embodiment of the invention.

The "bandwidth change indication" message can only be initiated by the network or called user for the connection when it is in an active state (i.e. the connection is fully established). It is possible that when the "bandwidth change indication" message arrives at a network node in the upstream, the call/connection may not be in an active state.

When it receives the "bandwidth change indication" message, the connection owner performs one of the following actions or as specified by dynamic bandwidth management option information element in the "setup" request: e.g., no action; release the connection; initiate the "connection modify" procedures by using the bandwidth information which is specified in the "bandwidth change indication" message; and re-route the connection.

Messages

According to one embodiment, the messages to be used are described in detail below:

(1) "setup" message

Message type:	Setup
Significance:	Global
Direction:	Both

Table 1 below shows additional content of the setup message

Information Element	Reference	Direction	Type	Length
Dynamic Bandwidth Management Options	(Note 1)	both	O	5

Note 1: No section is assigned.

(2) "bandwidth change indication" message

Message type: Bandwidth change indication
Significance: Global
Direction: Both

Table 2 below shows "bandwidth change indication" message contents according to one embodiment.

Information Element	Reference	Direction	Type	Length
Protocol Discriminator	5.4.2 (UNI) 6.4.2 (PNNI)	both	M	1
Call Reference	5.4.3 (UNI) 6.4.3 (PNNI)	both	M	4
Message Type	5.4.4.1 (UNI) 6.4.4.1 (PNNI)	both	M	2
Message Length	5.4.4.2 (UNI) 6.4.4.2 (PNNI)	both	M	2
Alternative ATM traffic descriptor	ATM Forum UNI Signalling 4.0, Section 8.1.2	both	Option (see Note 2)	4-30
Minimum acceptable ATM traffic descriptor	ATM Forum UNI Signalling 4.0, Section 8.1.2	both	Option (see Note 2)	4-20

Reference: The section numbers which are stated in this column will have different number for ATM Forum UNI Signalling Specification and ATM Forum PNNI Signaling Specification. Therefore, the "UNI" and "PNNI" are used to indicate the appropriate specification for reference.

Note 2: Either the alternative ATM traffic descriptor information element or minimum acceptable ATM traffic descriptor information element, but not both, shall be included in the "bandwidth change indication" message when traffic parameters are requested.

Dynamic Bandwidth Management Option Information Element

The purpose of the dynamic bandwidth management option IE is to describe the management option that is specified by the connection owner. It is used to deal with dynamic bandwidth changes when the

connection is active. This IE is specified by the connection owner during initial "setup" procedure. If this IE is absent, it implies that no management action is expected. This approach is backwards compatible to UNI 4.0 and PNNI V1.0 signalling specifications.

Table 3 below shows a dynamic bandwidth management option indicator (Figure 2 octet 5)

Bits 8 7 6 5 4 3 2 1	Meaning
0 0 0 0 0 0 0 0	Clear connection, if insufficient bandwidth (see Note 3)
0 0 0 0 0 0 0 1	specify the new bandwidth (see Note 4)

Note 3: If the management option is specified to clear call when there is insufficient bandwidth, the network or the called user will initiate the "release" message.

Note 4: If the management option is specified to the new bandwidth-requirements, the network or the called user will initiate the "bandwidth change indication" message to the calling user and will include the expected bandwidth in the message. As a result, the connection owner may initiate the connection modify procedures if the specified bandwidth is acceptable.

Signalling Procedures

If the connection owner request dynamic bandwidth management capability, it specifies the type of management options it desires from the network and the called party. This IE is included in the "setup message".

Across the UNI and PNNI interfaces, bilateral agreements may be required across the network providers to support an end-to-end solution for dynamic bandwidth management.

Figure 3 shows one example of flows of "bandwidth change indication" and "connection modify" messages.

Procedures for "setup" at the transit entity

Upon receiving the "setup" message with the dynamic bandwidth management option specified, the network shall not modify the contents of this IE. It records the dynamic bandwidth management option, if

supported. It then processes the "setup" message in the normal manner and forwards the IE towards the called user.

If the network/user does not support the requested dynamic bandwidth management option, it shall treat the IE as the unrecognized IE and process the SETUP message according to the action indicator as specified in the IE.

Procedures for "setup" at the destination entity

Upon receiving the "setup" message with the dynamic bandwidth management option specified, the network/user records the dynamic bandwidth management option, if supported. It then processes the "setup" message in the normal manner.

If the network/user does not support the requested dynamic bandwidth management option, it shall treat the IE as the unrecognized IE and process the SETUP message according to the action indicator as specified in the IE.

Procedures for "connect" at the destination entity

Upon constructing the "connect" message, if the dynamic bandwidth management option was specified in the "setup" message and the network/user supports the management option, it shall include the dynamic bandwidth management option IE which is the same as the one in the "setup" message. The "connect" message is then forwarded towards the calling party in the normal manner.

Procedures for "connect" at the transit entity

Upon receiving the "connect" message which contains the dynamic bandwidth management option, the network shall not modify the contents of the IE and processes the "connect" message in the normal manner.

Procedures for "connect" at the originating entity

Upon receiving the "connect" message which contains the dynamic bandwidth management option, it is the indication that the requested management option is supported end-to-end.

Otherwise, it is the indication that at least one of the transit entities does not support the dynamic bandwidth management option. The decision of how to handle this call/connection establishment is connection owner's local implementation decision and is not subjected to this specification.

Procedures for handling dynamic bandwidth changes at the affected network element

When the network or called user detects the bandwidth changes at the local switch (e.g. congestion or recovery from congestion), the network or the called user may decide to change the connection bandwidth to the level that it can support.

The following management actions may happen:

1. If no dynamic bandwidth management option was specified, the maintenance action may be local implementation decision and no obligation for any particular management action to the connection owner.
2. If the bandwidth is required to be reduced for a connection and the management option was specified to clear the connection (i.e. option 0), the network or the called user shall initiate the "release" message with cause (user cell rate not available) and without the Fault Tolerant Re-routing information (i.e. no Fault Tolerant Re-routing).
3. If the bandwidth is required to be reduced for a connection and the management option was specified to identify the new bandwidth requirements (i.e. option 1), the designated side of the network-network/user-network interface shall initiate the "bandwidth change indication" message which is encoded with the expected traffic parameters to be modified. A timer shall be set by the network/user to wait for the connection owner maintenance action. The state shall be changed to "awaiting resource management". The decision, that whether the network/user shall retry for sending another "bandwidth change indication" message when the timer expires, is local implementation dependence. The possible local maintenance action to deal with the expiration of the timer can be: re-send "bandwidth change indication" message, release the connection or do nothing.

4. If the bandwidth is required to be increased or restored and the management option was specified to the new bandwidth requirements (i.e. option 1), the designed side of the network-network/user-network shall initiate the "bandwidth change indication" message which is encoded with the expected traffic parameters to be modified. A timer shall be set by the network/user to wait for the connection owner's maintenance action. The state shall be changed "awaiting resource management". The decision, that whether the network/user shall retry for sending another "bandwidth change indication" message when the timer expires, is local implementation dependence. The possible local maintenance action to deal with the expiration of the timer can be: re-send "bandwidth change indication" message, release the connection or do nothing.

It is possible that the network or called user may have changed the bandwidth at the local switch due to severe congestion prior to receiving the maintenance action from the connection owner. Nevertheless, the "bandwidth change indication" message shall be initiated, if permitted, and include the expected bandwidth that is adopted by the local switch for the connection. A timer shall be set by the network/user to wait for the connection owner's maintenance action. The state of the call shall be changed to "awaiting resource management" after the "bandwidth change indication" message was sent. The decision, that whether the network/user shall retry for sending another "bandwidth change indication" message when the timer expires, is local implementation dependence. The possible local maintenance action to deal with the expiration of the timer can be: re-send "bandwidth change indication" message, release the connection or do nothing.

Procedures for "bandwidth change indication" at the transit entity

Upon receiving the "bandwidth change indication" message, the network may wish to modify the traffic parameters in the message if the bandwidth at the local switch for the given connection is required to be lower than the rate specified in the message. If so, a timer shall be set by the network to wait for the connection owner's maintenance action. The state of the call shall be changed to "awaiting resource management".

The network shall then forward the message with a lower rate towards the calling user. The decision, that whether the network/user shall retry for sending another "bandwidth change indication" message when the timer expires, is local implementation dependence. The possible local maintenance action to deal with the expiration of the timer can be: re-send "bandwidth change indication" message, release the connection or do nothing.

Procedures for the connection owner when receiving "bandwidth change indication" message

If the connection owner supports the dynamic bandwidth change capability with option 1 (i.e.-specify the new resource requirement) specified, and able to adopt the expected bandwidth which is indicated in the "bandwidth change indication" message, it shall initiate the Q.2963.2 (connection modify) procedures with the given traffic parameters.

If the connection owner supports the dynamic bandwidth change capability with option 1 but it could not adopt the expected bandwidth which is indicated in the "bandwidth change indication" message, it shall release the connection or to reroute the connection.

It is possible to have multiple "bandwidth change indication" messages sent from the network or called user to the connection owner. However, it is a local implementation decision for the connection owner to deal with these multiple indications. In ITU-T Q.2963.2, section 5.1 clearly states that one and only one modification can be requested by the connection owner at one time. Therefore, the connection owner may wish to buffer the indications in the sequence of which they arrive; or the connection owner may simply discard the subsequent indications until the current modification procedures are completed.

This invention does not impose the network nor the called user to set a timer to wait for the ITU-T Q.2963.2 (connection modify)-procedures from the calling user. It is a local implementation decision for setting a timer after initiating the "bandwidth change indication" message. In some cases, the network or the called user may have to adjust the cell rate prior to receiving the "connection modify" request because of severe congestion in the local switch. As the "bandwidth change indication"

message traverses towards the calling user and the connection is in an active state, any network node along the path is allowed to update the traffic parameters if a lower rate is required.

At the egress side of an ATM network, if the connection is waiting for Fault Tolerant Re-routing "setup", the network shall not forward the "bandwidth change indication" message from the succeeding side towards the calling user until the new connection is re-established. When the connection owner receives the "bandwidth change indication" message and the connection is in an active state, it may perform one of the following actions:

- Initiate the ITU-T Q.2963.2 procedures with the cell rate specified in the "bandwidth change indication" message.
- Release the connection if there is insufficient bandwidth to support the connection.
- Reroute the connection if an alternative path is found to sustain the bandwidth requirements of the connection.

In the case that the connection owner requests the connection to be cleared when there is insufficient bandwidth, there is no restriction of which side of the troubled link can initiate the "release" message since the signalling protocols can handle the simultaneous release requests.

We Claim:

1. In an ATM network, a method of managing the resource demand of an active connection comprising steps of:

receiving a resource change message at a connection owner, the message indicating a resource change request;

sending downstream a resource management option chosen in response to the resource change request; and

exchanging traffic on the connection conforming to the resource management option when said option is acknowledged.

2. The method of managing the resource demand of an active connection, according to claim 1, comprising further steps of:

deciding on one out of more than one resource management option available at the connection owner;

sending a modify message downstream of the connection indicating a new resource requirement for the connection; and

exchanging traffic on the connection conforming to the new resource requirement when the modify message is acknowledged.

3. The method for managing the resource demand of an active connection, according to claim 2, comprising a further step of:

sending downstream a setup message indicating resource management options available at the connection owner.

4. The method for managing the resource demand of an active connection, according to claim 4, comprising a further step of:

receiving at the connection owner a connect message acknowledging the new resource requirement.

5. The method for managing the resource demand of an active connection, according to claim 1, wherein the step of receiving a resource change message comprises a step of:

receiving the resource change message which includes an expected resource demand.

6. The method for managing the resource demand of an active connection, according to claim 5, further comprising steps of

rerouting the active connection to meet the expected resource demand; and

exchanging traffic on the rerouted connection.

7. The method for managing the resource demand of an active connection, according to claim 2, wherein the step of receiving a resource change message comprises a step of:

receiving the resource change message which includes one of the following parameters:

an alternative ATM traffic descriptor information element to indicate the overall changes to the connection cell rate for a CBR or VBR connection; and

the minimum acceptable ATM traffic descriptor information element to indicate the changes for the peak cell rate parameters for a CBR, VBR, ABR, UBR or GFR connection.

8. The method for managing the resource demand of an active connection, according to claim 4, comprising further step of:

setting either a timer or a number of retry for the connection owner to perform its maintenance action.

9. The method for managing the resource demand of an active connection, according to claim 6, comprising further step of:

setting either a timer or a number of retry for the connection owner to perform its maintenance action.

10. In an ATM network, a method of changing the bandwidth of an active connection comprising steps of:

receiving a resource change message on the connection at a connection owner, the message indicating a bandwidth change request;

sending a modify message downstream of the connection indicating a new bandwidth for the connection; and

sending traffic on the connection having the new bandwidth when the modify message is acknowledged.

11. The method of changing the bandwidth of an active connection, according to claim 10, comprising a further step of:

sending downstream a setup message indicating bandwidth management options available at the originating user.

12. The method for managing the resource demand of an active connection, according to claim 11, comprising a further step of:

receiving at the connection owner a connect message acknowledging the new bandwidth.

13. The method for managing the resource demand of an active connection, according to claim 10, comprising a further step of:

sending downstream a setup message indicating the following resource management options available at the connection owner:

no action;

clear the connection, if there is insufficient bandwidth; and

request bandwidth modification, if possible.

14. The method of managing the resource demand of an active connection, according to claim 13, comprising further steps of:

deciding on one resource management option which is the request bandwidth modification, if possible;

sending a modify message downstream of the connection indicating a new bandwidth for the connection; and

receiving at the connection owner, a connect message acknowledging the new bandwidth for the connection.

15. The method for managing the resource demand of an active connection, according to claim 10, wherein the step of receiving a resource change message comprises a step of:

receiving the resource change message which includes an expected bandwidth.

16. The method for managing the resource demand of an active connection, according to claim 15, further comprising steps of

rerouting the active connection to meet the expected bandwidth; and

exchanging traffic on the rerouted connection.

17. The method for managing the resource demand of an active connection, according to claim 10, wherein the step of receiving a resource change message comprises a step of:

receiving the resource change message which includes one of the following parameters:

an alternative ATM traffic descriptor information element to indicate the overall changes to the connection cell rate for a CBR or VBR connection; and

the minimum acceptable ATM traffic descriptor information element to indicate the changes for the peak cell rate parameters for a CBR, VBR, ABR, UBR or GFR connection.

18. The method for managing the resource demand of an active connection, according to claim 12, comprising further step of:

setting either a timer or a number of retry for the connection owner to perform its maintenance action.

19. The method for managing the resource demand of an active connection, according to claim 14, comprising further step of:

setting either a timer or a number of retry for the connection owner to perform its maintenance action.

20. The method for managing the resource demand of an active connection, according to claim 16, comprising further step of:

setting either a timer or a number of retry for the connection owner to perform its maintenance action.

21. An interface for managing the resource demand of an active connection in an ATM network, comprising;

a receiver for receiving a resource change message, the message indicating a resource change request;

a controller for selecting a resource management option in response to the resource change request;

a transmitter for sending downstream a message indicating the chosen resource management option; and

the said receiver and transmitter for exchanging traffic on the connection conforming to the resource management option when said option is acknowledged.

22. The interface for managing the resource demand of an active connection in an ATM network, according to claim 21, further comprising:

the transmitter for sending a setup message which includes a plurality of available resource management options; and

the receiver for receiving a bandwidth change request indicating a desired bandwidth.

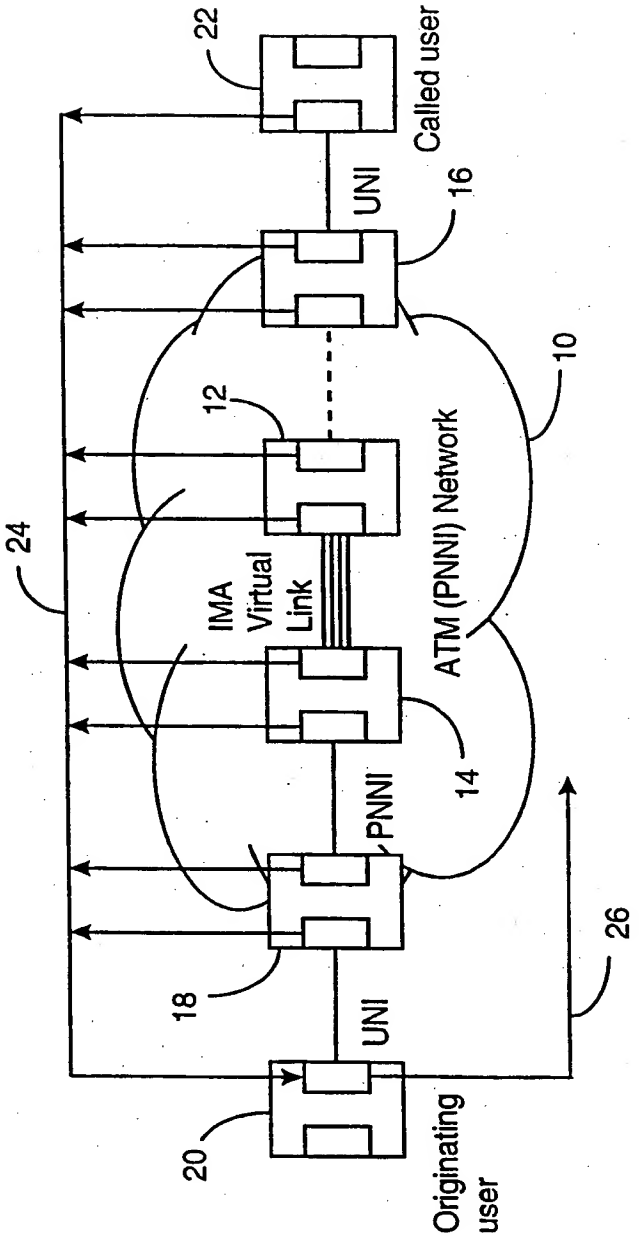
22
Called user
UNI
16
10
12
ATM (PNNI) Network
24
IMA
Virtual
Link
14
PNNI
26
18
UNI
20
Originating
user

Fig 1

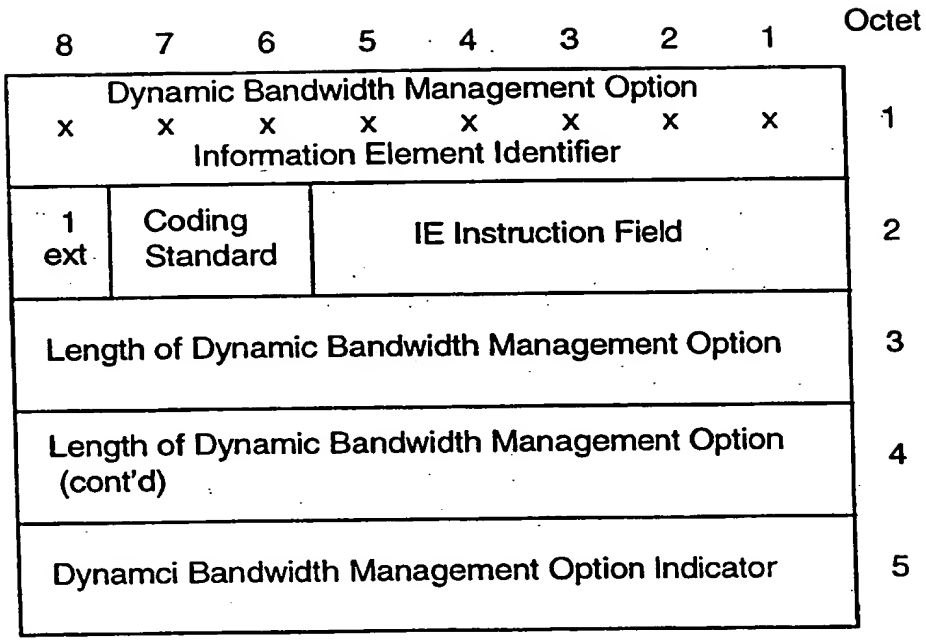
8 7 6 5 4 3 2 1
Octet
Dynamic Bandwidth Management Option
x x x x x x x x
Information Element Identifier
1
1
ext
Coding
Standard
IE Instruction Field
2
Length of Dynamic Bandwidth Management Option
3
Length of Dynamic Bandwidth Management Option
(cont'd)
4
Dynamci Bandwidth Management Option Indicator
5

Fig 2

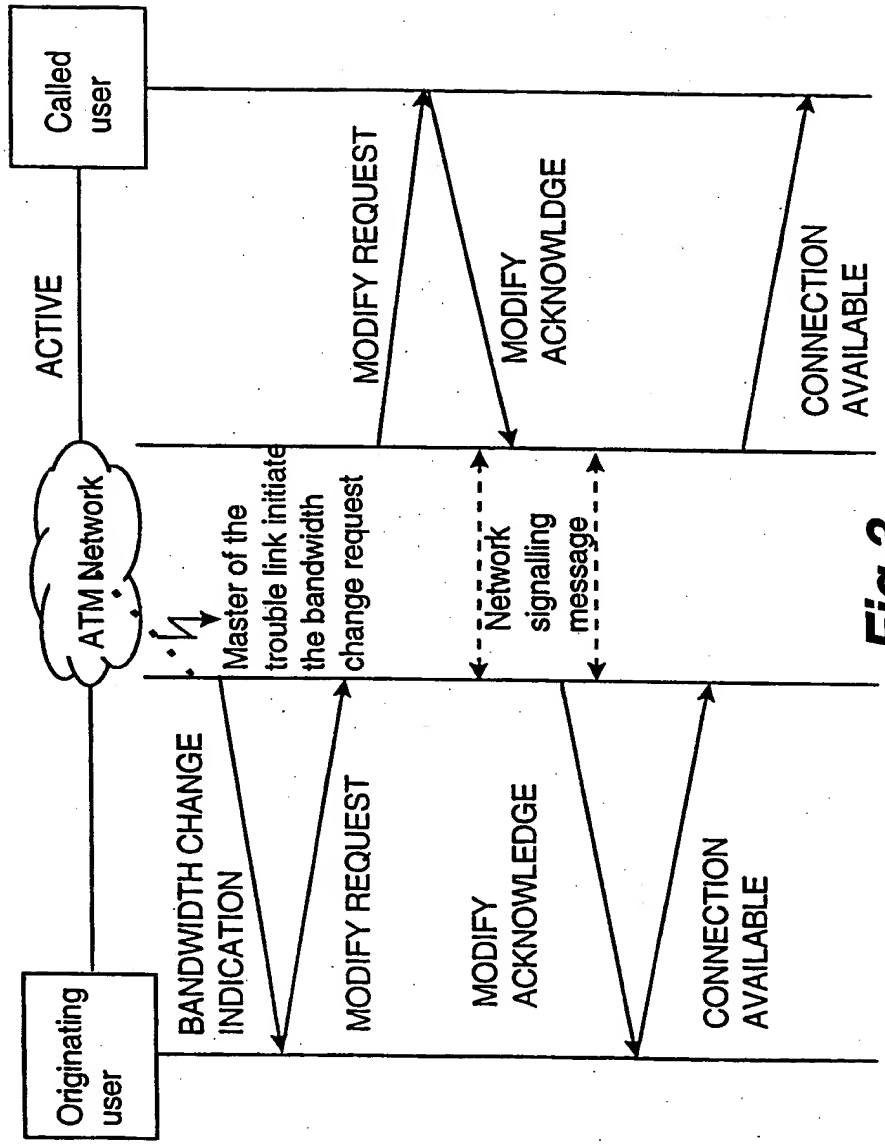

Fig 3

INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/CA 98/00391

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q11/04

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04Q

Documentation searched other than minimumdocumentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	MARCO DE M ET AL: "BANDWIDTH RE-NEGOTIATION IN ATM NETWORKS FOR HIGH-SPEED COMPUTER COMMUNICATIONS" GLOBECOM '95. IEEE GLOBAL TELECOMMUNICATIONS CONFERENCE, SINGAPORE, NOV. 14 - 16, 1995, vol. VOL. 1, 14 November 1995, pages 393-398, XP000621517 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS see paragraph 1 see paragraph 2 --- -/--	1,10,21

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of theinternational search	Date of mailing of the international search report
13 August 1998	21/08/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Staessen, B

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INTERNATIONAL SEARCH REPORT

Inter onal Application No
PCT/CA 98/00391

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	YUAN R ET AL: "A SIGNALING AND CONTROL ARCHITECTURE FOR MOBILITY SUPPORT IN WIRELESS ATM NETWORKS" 1996 IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS (ICC), CONVERGING TECHNOLOGIES FOR TOMORROW'S APPLICATIONS DALLAS, JUNE 23 - 27, 1996, vol. VOL. 1, 23 June 1996, pages 478-484, XP000625718 INSTITUTE OF ELECTRICAL & ELECTRONICS ENGINEERS see abstract see paragraph 4.4 ---	1,10,21
A	GB 2 306 073 A (NIPPON ELECTRIC CO) 23 April 1997 see abstract; claim 1 ---	1,10,21
A	DOSHI B T ET AL: "PERFORMANCE AND ROLES OF BANDWIDTH AND BUFFER RESERVATION SCHEMES IN HIGH SPEED NETWORKS" FUNDAMENTAL ROLE OF TELETRAFFIC IN THE EVOLUTION OF TELECOMMUNICATI NETWORKS, PROCEEDINGS OF THE 14TH. INTERNATIONAL TELETRAFFIC CONGRESS - ITC 1 JUAN-LES-PINS, JUNE 6 - 10, 1994, no. VOL. 1A, 6 June 1994, pages 23-34, XP000593396 LABETOULLE J;ROBERTS J W (EDS) see paragraph 9.2 ---	1,10,21
A	LEE W C ET AL: "DYNAMIC CONNECTION MANAGEMENT FOR CALL-LEVEL QOS GUARANTEE IN INTEGRATED COMMUNICATION NETWORKS" PROCEEDINGS OF THE CONFERENCE ON COMPUTER COMMUNICATIONS (INFOCOM), TORONTO, JUNE 12 - 16, 1994, vol. VOL. 3, 12 June 1994, pages 1073-1082, XP000496568 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS see paragraph 3 see paragraph 5 ---	1,10,21
A	CROSBY S: "IN-CALL RENEGOTIATION OF TRAFFIC PARAMETERS" NETWORKING: FOUNDATION FOR THE FUTURE, SAN FRANCISCO, MAR. 28 - APR. 1, 1993, vol. VOL. 2, no. CONF. 12, 28 March 1993, pages 638-646, XP000399044 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS see paragraph 1 -----	1,10,21

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter nal Application No
PCT/CA 98/00391

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2306073 A	23-04-1997	US 5675384 A	07-10-1997
		JP 9172642 A	30-06-1997

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